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ACROMEGALY, WITH THE DESCRIPTION OF A
SKELETON. By HENRY ALEXIS THOMSON, M.D.,
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burgh.*

ALTHOUGH but four years have elapsed since the appearance in the *Revue de Médecine* of M. Pierre Marie's original description of Acromegaly, a number of valuable papers have been published both in Europe and America, in which this newly-christened disease is discussed more or less exhaustively by different writers, and medical literature already supplies an abundant store of clinical cases for the most part described under the name devised by Marie. Many isolated cases also have been discovered by diligent search in previous records, these older cases having been regarded by their observers at the time of publication, in the majority of instances, as of the nature of myxodœma. A certain amount of doubt still exists as to the exact combination of symptoms which constitute acromegaly, but M. Marie's description is generally accepted as affording the means of recognising the disease, and of differentiating it from others which simulate it more or less closely. A greater uncertainty, however, exists in relation to the pathology of acromegaly, the disease being comparatively rare, and the opportunities which have occurred of examining the cases after death very few in number. Moreover, the recorded results of such examinations do not agree with one another sufficiently to permit of definite conclusions being drawn as to the etiology of the disease.

The following case is in many respects a valuable addition to those already recorded, and has a somewhat eventful history. During life, the patient, a man of thirty-six, came under Dr Claud Muirhead's care in the Royal Infirmary in 1878, on

account of diabetes mellitus. After death his body was brought to the Dissecting Rooms of the University of Edinburgh, where it was submitted to an exhaustive examination by Dr D. J. Cunningham, then senior Demonstrator of Anatomy, who published a masterly account of the external appearances of the man, and of a number of pathological changes observed in the dissection, in a paper in the *Journal of Anatomy and Physiology* for 1879,¹ under the title of "A Large Subarachnoid Cyst involving the Greater Part of the Parietal Lobe of the Brain." The skeleton was macerated and preserved by Professor Sir William Turner, with the intention of placing it in the Anatomical Museum. On the specimen being referred to the writer for the purpose of being included in the new Catalogue in course of preparation, it was recognised as having belonged to a case of acromegaly. As only two skeletons from similar cases have been hitherto described,—one by A. Broca² and another by Virchow,³—I shall give a full account of the changes observed in this specimen, and I have to record my great indebtedness to Sir William Turner for the valuable help and guidance I have received from him in the course of my work.⁴

For the convenience of those who are not familiar with the more exhaustive papers on acromegaly already published, I shall give a very brief synopsis of the outstanding clinical features of the disease.

Acromegaly may occur at any period of life, but is most frequent in young adults. The onset is insidious, so that the date at which the disease commenced is not always easy to determine with accuracy. The hands and feet become enlarged out of all proportion to the rest of the body, the enlargement being chiefly due to a hypertrophy of the soft parts which commences at the periphery of the extremities. The face becomes elongated and deformed as a result of the increase in size of the bones of the face, more especially of the inferior maxilla, while

¹ Vol. ix. The brain and the enormously distended stomach are preserved in the Anatomical Museum of the University.

² *Archives générales de Médecine*, December 1888.

³ *Berliner Klinische Wochenschrift*, February 1889.

⁴ Sir James Paget, to whom the skull and skeleton had been sent immediately after maceration by Sir Wm. Turner for an opinion, at once pronounced it not to be a case of osteitis deformans.

a forward subluxation of the latter frequently gives an unpleasant aspect to the face. The facial deformity is added to by the prominence of the superciliary ridges and the hypertrophic thickening of the lower lip, tongue, nose, ears, and eyelids. The cranium itself may participate in these hypertrophic changes, and may show an increase in all its dimensions. Headache is frequently complained of, the sight may be impaired or altogether lost, speech is sometimes interfered with, the appetite and thirst are usually exaggerated, and in quite a number of cases diabetes mellitus is found to be present. In women there is usually amenorrhœa. The mental and muscular functions are unimpaired, so that the patient is usually able to continue his occupation, provided this be compatible with the deformities of the hands and face. The progress of the disease is slow, there being but little advance during a period of many years. In advanced cases the muscles become weak, and spinal deformities tend to develop. These usually consist in a kyphosis of the cervico-dorsal region, with sinking of the head between the shoulders; sometimes there is also a scoliosis in the dorso-lumbar region.

The patient ultimately dies from exhaustion, or some intercurrent affection. In every case in which the body has been examined, with one exception,¹ the pituitary body has been found to be very greatly enlarged by a hyperplasia of its normal elements, and a similar hypertrophy affects the ganglionic cords and larger trunks of the sympathetic nervous system.

In some cases the thymus is persistent while the thyroid is said to undergo a process of atrophy.²

The following statements referring to the *Clinical History and Anatomical Examination* of the case of acromegaly here recorded are extracted from Dr Cunningham's paper, to which reference has already been made:—

The patient, a fireman, aged 36, was admitted to the Royal Infirmary in 1878, suffering from diabetes mellitis. Dr Claud Muirhead, under whose care he was placed, described him "as a man of huge frame, with an unpleasing expression and overhanging brows; his hands and feet were enormously large and flat, and his movements clumsy and ungainly. His voice was strong, deep and hoarse.

¹ In the case recorded by Virchow, *Berlin. Klin. Wochenschr.*, Feb. 1889.

² In the cases recorded by Henrot and Godlec, the thyroid was considerably enlarged.

He had no symptoms of paresis or paralysis, and his sight and hearing were unimpaired. His expression was heavy, dull, and stupid, utterly devoid of anything like active intelligence. He was easily irritated, and though sometimes he gave vent to this in a fit of passion, more commonly he exhibited it by hysterical weeping, and in this way his fits of anger invariably terminated. He was entirely uneducated. He died of diabetes mellitus."

When placed in the dissecting rooms the unusual bulk and peculiar appearance of the subject attracted universal attention.

He was a man of a forbidding and low cast of features. His head and thorax were peculiarly large, his limbs were spare, though his hands and feet were enormous. He was 6 ft. 0½ in. in height.

The bones were very large and out of proportion to the muscular development of the subject. The enlargement of each bone was uniform and symmetrical. The bones of the skull were remarkably thick; the supereiliary ridges were very pronounced and the frontal air-sinuses of great extent. The pituitary fossa had undergone a great expansion from hypertrophy of the pituitary body.

The muscles were poorly developed and quite out of keeping with the huge frame upon which they had acted.

The brain weighed 50 oz. 6 dr. There was a large subarachnoid cyst involving the greater part of the right parietal lobe of the brain, containing sero-sanguinolent fluid and large enough to hold a hen's egg. The pituitary body was greatly hypertrophied, being four or five times its usual size. It was exceedingly soft and pulpy, and the greatest difficulty was experienced in raising it entire, from the expanded pituitary fossa in which it had rested. It was fully as large as a walnut, and it projected upwards from the expanded fossa so as to press upon the base of the brain. The space bounded behind by the pons Varolii, in front by the frontal lobes, and laterally by the temporo-sphenoidal lobes, was hollowed out into a deep recess for its reception. The enlargement of this area was entirely confined to that part of it which is situated in front of the corpora albicantia. The crura cerebri and pons Varolii had successfully resisted the encroachment of the pituitary body in a backward direction. Owing to the deepening of the space, the corpora albicantia had been brought under the shelter of the pons, and thus they had escaped the results of the pressure.

The frontal lobes, which limit the space in front, had given way before the enlarging pituitary, and in consequence they had sustained a loss of substance.

In the floor of the space the optic commissure had been pushed forwards so as to lie altogether in front of the lamina cinerea. The tuber cinereum and the lamina cinerea were very much thinned, and the former was connected by a large infundibulum with the pituitary body. The optic tract and commissure and the commencement of the optic nerves were rendered perfectly flat by the pressure. Upon each side the optic tract was directly continuous with the tuber cinereum and lamina cinerea. The optic commissure, on the other

hand, was continuous with the anterior part of the lamina cinerea, and together they formed a thin plate of nervous matter which projected forwards so as to overlap the commencement of the median longitudinal fissure. On raising this lamina, a circular aperture, which led into the third ventricle of the brain, was brought into view.

In the sympathetic nervous system there was simply an enlargement of the splanchnic nerves, more marked on the left side. This is to be associated with the hypertrophy of the abdominal viscera.

At the end of this paper, Cunningham laid special stress on the enlargement of the pituitary gland in conjunction with the great bulk of the body, and he regarded the case as the second in which "general progressive hypertrophy" had been associated with such enlargement, the first having been recorded by Henri Henrot, in 1877, in the "*Union Médicale et Scientifique du Nord-Est*."

I shall now give a description of the macerated skeleton.

THE SKELETON.

As has been already stated, the skeleton is that of a male subject, probably from his name a Scotchman, aged 36, and 6 feet in height; the constituent bones are therefore free from the various degenerative changes which may accompany old age, and they do not show any alterations which may be attributed to errors in development.

In taking a general survey of the different parts of the skeleton, what prominently attracts attention is the condition of the skull, although the other bones are not without features worthy of description, in virtue of its peculiar giant-like appearance and facial outlines. On comparing it with other skulls from subjects of similar age and stature, its peculiarity is seen to chiefly depend on the disproportionate increase in the dimensions of the face; the latter is more elongated than broadened, and the elongation is mainly due to an increase in the vertical diameter of the superior and inferior maxillæ. It is further noticed, in profile view, that the facial angle is diminished because of the anterior projection of the chin, a condition which is also to be estimated by looking at the skull from above (the beginning of the sagittal suture being in the centre of the prospective plane), the incisor teeth are then seen in front of the supra-orbital ridges, while the zygomata come into view on either side. Both in full face and profile view the superciliary ridges are large and prominent, and project in front of the

glabella; by overhanging the orbital cavities they impart a frowning and forbidding aspect to the skull as a whole, and cause a deep depression at the fronto-nasal suture. The malar bones project, but there is no evidence of dilatation of the maxillary sinuses, described by A. Broca as characteristic of acromegaly, and as the cause of the prominence of the cheeks during life.

The Dimensions and Characters of the Skull in Detail.—The dimensions of the skull may be gathered from the following measurements, in which I have followed the mode of measuring employed by Sir William Turner in his "Challenger" Report on Human Crania¹:—

Cubic capacity, 1580 c.c.; glabello-occipital length, 200 mm.; basi-bregmatic height, 142 mm.; *vertical index*, 71; minimum frontal diameter, 101 mm.; stephanic diameter, 129 mm.; asterionic diameter, 115 mm.; greatest parieto-squamous breadth, 148 s. mm.; *cephalic index*, 74; horizontal circumference, (a) around superciliary ridges, 567 mm., (b) immediately above the ridges, 561 mm.; frontal longitudinal arc, 147 mm.; parietal longitudinal arc, 138 mm.; occipital longitudinal arc, 133 mm.; total longitudinal arc, 418 mm.; vertical transverse arc, 333 mm.; length of foramen magnum, 33 mm.; basi-nasal length, 106 mm.; basi-alveolar length, 105 mm.; *gnathic index*, 99.1; interzygomatic breadth, 150 mm.; intermalar breadth, 126 mm.; naso-alveolar length, 81 mm.; nasal height, 59 mm.; nasal width, 24 mm.; *nasal index*, 40.7; orbital width, 45 mm.; orbital height, 36 mm.; *orbital index*, 80; palato-maxillary length, 67 mm.; palato-maxillary breadth ap., 70 mm.; *palato-maxillary index*, 104.4. Lower jaw: symphysial height, 46 mm.; coronoid height, 96 mm.; condyloid height, 90 mm.; gonio-symphysial length, 103 mm.; intergonial width, 101 mm.; breadth of ascending ramus, 36 mm.

In the three great dimensions of length, breadth, and height the cranial box considerably exceeds the normal size. It is seldom that a Scottish skull equals 200 mm. in length, 140 mm. in height, and 140 mm. in its greatest breadth, as appears from tables of measurement of Scottish skulls made by Sir William Turner, to which I have had access. The cubic capacity also is

¹ *Zool. Chall. Exp.*, part xxix., 1884.

considerably above the normal, and along with this the horizontal circumference is unusually large. The skull may, therefore, be called megacephalie. The longitudinal arc and the vertical transverse are greatly exaggerated, and the transverse dimensions of the face, as shown by the interzygomatic and intermalar breadth are remarkable; but there are no measurements which are more characteristic of acromegaly, as showing an increase in growth, than the naso-alveolar height, the nasal height, and the symphysial height, all of which are greatly exaggerated.

The remarkable elongation of the face in the vertical diameter is perhaps most strikingly demonstrated by taking the diameter from the fronto-nasal suture to the symphysis of the lower jaw, the measurement of which is 148 mm., and comparing it with the same diameter in a series of ten adult male Scotch crania in Sir W. Turner's collection, of which the average measurement is 124.5 mm.

The sagittal and lambdoidal sutures are extensively obliterated. The ridges for muscular attachment are prominent throughout; the median ridge on the tabular part of the occiput, which gives attachment to the ligamentum nuchæ, is represented by a ridge of bone, 6 mm. in height. The external orifice of the external auditory meatus is considerably enlarged, rendering the canal funnel-shaped or conical, with the apex at the membrana tympani.

The orbital cavities are increased in size, their transverse diameter being disproportionately large. The nasal septum shows a deviation to the right, to such a degree as, when clothed with mucous membrane, to practically obliterate the nasal cavity on that side. The upper jaw is markedly elongated in the vertical direction, especially in the interval between the inferior orbital border and the alveolar border. The region of the incisor fossæ is very distinctly concave forwards, giving a somewhat prognathous aspect to the upper jaw. In the region of the canine fossæ there is a certain appearance of lateral compression of the jaw. The suture of articulation between each superior maxilla and its malar bone is obliterated, and the bones are roughened and tuberculated along the line of the obliterated suture. The thickening of the bone in this region contributed, with the overhanging superciliary ridges, to

give that unpleasing expression to the face which was recognised during life. The alveolar margin is massive and spongy. Owing to most of the molar teeth having been shed, the corresponding part of the arch has been to some extent absorbed. The palatal arch is elongated, relatively narrow, and deeply concave; it shows a ridge of recent spongy bone in the middle line along the junction of the constituent plates. The surfaces of the latter are perforated like a sieve by vascular foramina. The glenoid cavity has a capacity little less than that of half a walnut, and in shape it resembles a circular fossa rather than a transverse groove. The enlargement of the cavity has occurred at the expense of its anterior boundary, for, in place of the eminentia articularis, there is a large excavation encroaching on the zygomatic process itself on the left side. These alterations in the glenoid resemble somewhat the common enlargement of joint-sockets met with in arthritis deformans, but with this important difference, that in the latter the articular surfaces become smooth and polished (eburnated), and their margins are the seat of considerable deposit of new bone, commonly spoken of as osteophytes, while in the specimen before us the floor of the cavity is irregular and rough, and there is not a trace of new bone in its immediate neighbourhood.

This expansion of the glenoids is to be associated with the large size of the condyles of the lower jaw, while the disappearance of the eminentia articularis allows the condyles to slide forwards to such a degree that the lower incisors may project beyond those of the upper jaw, causing the forward projection of the former bone and the tendency which it shows to subluxation, which have been observed during life in individuals suffering from acromegaly.¹

The lower jaw is extraordinarily large and massive; its body, which is of great depth, is inclined markedly forwards at the symphysis. The rami show a greater increase in their vertical than in their antero-posterior diameter, and join the body at an angle of $112^{\circ}5$. The lower border is greatly thickened. The alveolar margin is normal, and is filled with healthy teeth. The

¹ See a paper by Mr W. O. Chalk, in which he describes a case of acromegaly under the title of "Partial Dislocation of the Lower Jaw from an Enlarged Tongue," (*Trans. Path. Soc. Lond.*, 1857).

eoronoid process ascends to about a third more than its usual height. The condyles show a great increase in their transverse diameter, and are projected forwards and inwards towards the mesial plane of the head.

The foramen magnum is slightly contracted in its anteroposterior diameter, and is circular rather than oval; its margins are surrounded by irregular protuberances of spongy bone, especially around the condyles, and at the sites of attachment of the check ligaments. The cranial bones, as seen in the sawn section by which the calvarium was removed (at the level of the summit of the frontal sinuses), show alterations which are apparently of the nature of a hypertrophy of their normal structure, viz., an external and an internal plate of compact bone with intervening diploë, increased in thickness and in density. The thickness of the bones forming the cranial box varied from 6–12 mm. Herein lies the difference between the “hypertrophied” bone of acromegaly and the “diseased” bone of osteitis deformans (Paget); for in the latter the outer table becomes porous and spongy as a result of inflammatory changes, and the normal distinction between the outer and inner tables and diploë is lost, the entire thickness of the bone consisting of a uniform compact tissue in some parts resembling ivory and in others presenting a chalk-like appearance, which is very characteristic in the macerated skull. Apart from these structural alterations, the well-known tendency of osteitis deformans to be confined to the bones of the cranium, while those of the face are chiefly affected in acromegaly, furnish sufficient data for distinguishing the two diseases in an examination limited to the skull. The section made with the saw in removing the calvarium opened up the frontal sinuses, which were very considerably dilated, that on the left side measuring in the vertical diameter 45 mm., and in the horizontal 35 mm. The infundibulum leading into the middle meatus of the nose could readily be seen on looking down into the sinus. Although the sinuses corresponded in position to the superciliary ridges, the latter did not owe their prominence to the dilatation of the sinuses alone, for the anterior wall which constitutes the ridge was thick and massive, from the formation of new bone in relation to the external table of the skull in this situation.

In the interior of the skull the most striking change is undoubtedly the great enlargement of the pituitary fossa¹ produced by the atrophic pressure of the hypertrophied pituitary body which occupied it during life. The fossa is both deepened and widened, encroaching anteriorly on the olivary process, posteriorly on the dorsum sellæ; the latter is displaced backwards, is as thin as paper; its posterior clinoid processes have completely disappeared, and its superior border is irregularly toothed or serrated. The enlargement of the fossa has rendered the basilar process of the occipital more vertical and much shorter in its antero-posterior diameter. The floor of the fossa itself is pitted and perforated by numerous minute apertures. The increase in depth of the fossa has occurred at the expense of the body of the sphenoid, the latter being only about one-fourth of its normal vertical thickness. The sphenoidal sinus is not enlarged. As a result of the increased size of the pituitary fossa, the optic groove is obliterated and the optic foramina have become flattened from above downwards. The groove for the middle meningeal artery is deep and broad, but this is not so pronounced as is usually seen in osteitis deformans. Lastly, it may be noted that the anterior fossa of the skull is shallower than normal; this is to be accounted for by the large size of the frontal sinuses, and by the encroachment on the cranial cavity of the orbital plates of the frontal.

It may be convenient at this point to refer to the characters of the skull in one of M. Marie's cases of acromegaly, of which an admirable description has been published by M. A. Broca.² It belonged to a female subject, aged 54, and therefore possessed certain characters in which it differed from the one which I have described; in other respects the alterations in the skull were precisely the same in both specimens. The dimensions of the pituitary fossa given by Broca are identical with those here given. The dilatation of the mastoid, sphenoidal, and maxillary sinuses, upon which he lays special stress, do not exist in this

¹ The pituitary fossa measured in its antero-posterior diameter 22·5 mm., in its transverse diameter 21 mm., and in depth, below the plane of the summit of the clinoid processes, 18 mm.

² *Op. cit.*

specimen; the absence of this feature in the latter may probably be due to the fact that it belonged to a subject of 36, while Broca's case was aged 54 years.

Vertebral Column.—There are no evidences of any abnormal curvature having existed during life, from which it may be inferred that the patient succumbed at an earlier stage of the disease than is usually observed, on account of his having diabetes, and therefore he did not suffer from the muscular weakness characteristic of advanced acromegaly, which leads to antero-posterior and lateral curvatures of the spine, provided the patient in his weakened condition maintain the erect posture. The vertebræ are of large size, and exhibit in the dorsal and lumbar regions a series of projecting processes of recent spongy bone along the superior and inferior margins of their bodies, tending to bridge over the interval occupied by the intervertebral disc and corresponding to the anterior common ligament. In arthritis deformans (osteo-arthritis) the characteristic anatomical lesion when it affects the vertebræ, both of man and of animals, is a similar ossification of the anterior ligament, only this is present in a more advanced and extensive form. In a skeleton of acromegaly, recently shown by Virchow to the *Berliner Medizinischer Gesellschaft*, this lesion was also present together with similar bony developments in the extremities; in referring to these changes Virchow pointed out that osteo-arthritis approaches more closely to acromegaly than do osteitis deformans or leontiasis ossea, both of which present certain superficial resemblances to the disease described by Marie. Dr Georges Thibierge, in an able paper in the January number for 1890 of the *Archives générales de Médecine*, entitled “de l'Ostéite Déformante de Paget,” describes as characteristic of the latter a partial ossification of the vertebral ligaments or “ankylose externe.” In the Muscum of the Royal College of Surgeons there is a skeleton¹ of a woman aged 70 with well-marked rickets, in which the margins of some of the bodies of the dorsal and lumbar vertebra are “lipped” from a similar partial ossification of the anterior common ligament. It would appear, therefore, that bony deposits of a diffuse character may occur in acromegaly similar to those which occur in osteitis

¹ Spec. 678A. Injuries and Diseases of Bones.

deformans, osteo-arthritis, and rickets, and constitute only one element in the general trophic disturbance which accompanies these diseases.

Sternum, Ribs, and Costal Cartilages.—The sternum and ribs are of gigantic size; the longest of the latter, *i.e.*, the 7th, measuring 380 mm. along the convexity from end to end. The manubrium sterni appears of great transverse breadth on account of the complete incorporation with it of the ossified cartilages of the first rib on either side. The ensiform and remaining costal cartilages show various degrees of ossification, the process commencing on the outside, so that each cartilage becomes enveloped by a crust of new bone which has a porous structure and reticular arrangement, reminding one of the calcareous deposit seen on objects exposed to the contact of water containing an excess of lime salts. At either end of the cartilage the new bone is fused with the compact shell of its rib and with the sternum respectively. Such an extensive ossification of the cartilages is very unusual at the age of thirty-six; when taken in conjunction with the changes already described in the vertebræ, and with similar bony developments to be noted in the bones of the limbs, one may conclude that there exists in acromegaly a tendency to ossification of ligaments, cartilages, and connective tissues generally, exactly corresponding to what is seen in cases of osteo-arthritis, *viz.*, the development of large masses of bone in the substance of muscles and tendons in parts of the body distant from those affected by the arthritis itself.

The *Bones of the Extremities* present certain characters in common which may be referred to before I describe them individually. They are devoid of those elegant outlines which an anatomist is accustomed to look for in a well-formed skeleton; in appearance they are heavy and clumsy, this being probably due in large measure to the alteration in structure of their superficial layer. The latter, instead of being smooth and almost glistening, as it is in a properly macerated bone, presents a roughened spongy appearance with an infinite number of shallow longitudinal grooves, occupied in the recent state by blood-vessels entering the bone, evincing therefore an unusual degree of vascularity in the periosteum. The latter condition

is to be associated with the evidences of increased activity on the part of the periosteum, to be referred to in detail in the different bones of the extremities.

Upper Extremity.—The clavicles are specially large and bulky. The surface for articulation with the sternum is increased in all its diameters and it is deeply excavated in the shape of a dome, of which the vault is irregularly tuberculated and studded with large vascular openings. The only part capable of coming into contact with the sternum is the margin of this excavation. This deformity of the sterno-clavicular articulations again suggests osteo-arthritis, but is very easily distinguished from the latter by the entire absence of anything like eburnation or other result of joint-movement. Maximum length of clavicle, 180 mm.

In the *scapula* the large size of the glenoid articular surface is very noticeable, and is apparently due to a partial ossification of the glenoid ligament.

The *humerus* shows alterations in its head which correspond to the alterations just alluded to in the glenoid. The muscular ridges, more especially the external supracondyloid, are very prominent. Maximum length of right humerus, 348 mm.; of left, 330·6 mm.

The *radius* and *ulna* of the right side show very remarkable alterations of their superior articular surfaces. The head of the radius is excavated superiorly, and the surface by which it articulates with the ulna is greatly increased in its vertical measurement by a peculiar collar of newly-formed bone overhanging the neck of the radius, while the non-articular aspect is covered with large spongy projections (osteophytes).

The greater sigmoid cavity of the ulna is very much enlarged, its margin having been added to and extended by new bone resembling pumice stone. The articular surface of the cavity is covered with similar irregular rocky tubercles, which must have materially interfered with the flexion and extension movements of the elbow. The periosteal surface of the olecranon is also covered with rocky projections, most noticeable at the insertion of the triceps, while the same formation is seen at the attachment of the brachialis anticus to the coronoid process. These alterations, involving the elbow-joint and the bones in its

vicinity, again present certain resemblances to disease of this joint when affected with osteo-arthritis, and, at the risk of being guilty of repetition, I must again point out that these resemblances are superficial in character although they suggest a degree of affinity between the two diseases. Any one familiar with osteo-arthritis would have little difficulty in recognising the one from the other. Maximum length of right radius, 267 mm.; of left radius, 254 mm.; of right ulna, 282 mm.; of left, 273 mm.

The bones of the *wrist* and *hand* show but little evidence of having belonged to a subject to whose hands the epithet "enormous" had been bestowed by those who saw the man during life; it is, however, generally recognised that the remarkable hypertrophy of the hands and feet in acromegaly is due to an increase in the soft parts, and not to an enlargement of their osseous framework. The metacarpal of the thumb and all the phalanges are, however, actually broader and thicker, and the vicinity of their articular surfaces studded with irregular projections of new bone. The distal ends of the terminal phalanges are especially broad and similarly tuberculated.

Pelvis.—In taking the dimensions of the pelvis of the long bones I have followed the method employed by Sir William Turner in the "Challenger" Reports.¹

Breadth of pelvis, 311 mm.; height of pelvis, 233 mm.; *breadth-height index*, 74·9; between ant. sup. iliac spines, 271 mm.; between post. sup. iliac spines, 90 mm.; between ischial tubera, 166 mm.; greatest diameter of cotyloid cavity, 64 mm. (vert.); vertical diameter of obturator foramen, 60 mm.; transverse diameter of obturator foramen, 41 mm.; *obturator index*, 68·3; subpubic angle, 73°; transverse diameter of brim, 129; conjugate diameter of brim, 97 mm.; *pelvic index*, 75·2; intertuberal diameter, 105 mm.; depth of pubic symphysis, 50 mm.; depth of pelvic cavity, 103 mm.; length of sacrum, 99 mm.; breadth of sacrum, 121 mm.; *sacral index*, 123·2.

From these figures it will be seen that the pelvis is unusually large and bulky. The iliac crests are especially thick and prominent, as are also the other muscular ridges and tubercles. The ileo-pectineal line on the right side is raised into a pro-

¹ *Zool. Chall. Exp.*, part xlvii., 1886.

minent crest. The pelvic cavity answers to the obstetric term *justo-major*, were it not for the projection of the sacral promontory and of the ischial spines. The acetabulum is enlarged by a partial ossification of the cotyloid ligament, while its articulating surface is rough and irregular, and in the vicinity are numerous osteophytes and large vascular canals.

Inferior Extremity—Femur.—The shaft of the femur is especially clumsy in contour, and is unusually straight. The head of the bone shows alterations corresponding to those described in the acetabulum, chiefly shown by an encroachment of the articular surface of the head on the superior and anterior aspect of the neck. There is a partial ossification of the tendon of the obturator externus at its insertion into the digital fossa. On the posterior aspect of the shaft, immediately above the condyles, there is a circumscribed, elevated mass of spongy bone on either side, corresponding in situation to the two heads of origin of the gastrocnemius muscle. The maximum length of the right femur is 479 mm., of the left 487 mm.

The *tibia* and *fibula* on the left side show an extensive incrustation of the periosteal surfaces of their shafts with new bone, minutely perforated for blood-vessels, simulating closely the deposit which results from syphilitic periostitis.

The maximum length of the right tibia (not including spine) is 402 mm.; of the left, 392 mm.; of the right fibula, 392 mm.; of the left, 386.

The bones of the foot are not larger than one would expect to find in a man of 6 feet; those of the tarsus show small osteophytes at the insertions of the tendons. The metatarsals and the phalanges of the great toe are thick and flat, and show tubercles and ridges in the vicinity of their articular surfaces. The terminal phalanx of the hallux is specially deformed; at the proximal extremity the posterior angles incurve anteriorly, so as to form a crescent. Several of the phalanges of the other toes are ankylosed to each other.

In conclusion, the skeletal changes present in acromegaly may be summarised as follows:—

1. Changes peculiar to acromegaly.

- a. Enlargement of the pituitary fossa.

- β. Disproportionate hypertrophy of the bones of the face.

Together with these changes, which, so far as we at present know, do not occur in any other disease, we may include, as constant and fairly characteristic accompaniments, the dilatation of the air-sinuses of the skull; the uniform hypertrophy of certain portions of the skeleton other than the face, viz., those of the cranium, the clavicles, and the metacarpals and phalanges; and finally, the changes in the temporo-maxillary articulation, permitting of a forward subluxation of the lower jaw.

2. Changes which result from a tendency to the formation of new bone both in normal and abnormal situations. These are seen in the mildest form in the great prominence of the ridges for muscular and ligamentous attachment; to a further degree in the ossification of the costal and other cartilages; in the ossification of ligaments (glenoid, cotyloid, vertebral, &c.); in the ossification of tendons, and in the deposit of bone on the articulating surfaces, giving rise to osteophytes, spurious exostoses, ankyloses, alteration of articular surfaces, &c. In these respects the skeleton in acromegaly shows an approach to the changes met with in osteo-arthritis, and in a minor degree to those occurring in osteitis deformans.

The changes in the vertebræ, which result from the long-standing curvatures of the spine usually present in advanced cases of acromegaly, are precisely similar to those met with under other conditions.

The figure on the opposite page is a full-face view of the skull reproduced from a photograph.



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(For many of the references given here I am indebted to Marie's paper in *Brain*, pt. xlv., 1889, p. 59.)

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